ACOUSTICS AND AIR

CALDERWOOD MODIFICATION 4

AIR QUALITY ASSESSMENT

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GLOSSARY OF AIR QUALITY TERMS

Air Pollution – The presence of contaminants or pollutant substances in the air that interfere with human health or welfare or produce other harmful environmental effects.

Air Quality Standards – The level of pollutants prescribed by regulations that are not to be exceeded during a given time in a defined area.

Air Toxics – Any air pollutant for which a national ambient air quality standard (NAAQS) does not exist (i.e. excluding ozone, carbon monoxide, PM-10, sulphur dioxide, nitrogen oxide) that may reasonably be anticipated to cause cancer; respiratory, cardiovascular, or developmental effects; reproductive dysfunctions, neurological disorders, heritable gene mutations, or other serious or irreversible chronic or acute health effects in humans.

Airborne Particulates – Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Sources of airborne particulates include dust, emissions from industrial processes, combustion products from the burning of wood and coal, combustion products associated with motor vehicle or non-road engine exhausts, and reactions to gases in the atmosphere.

Area Source – Any source of air pollution that is released over a relatively small area, but which cannot be classified as a point source. Such sources may include vehicles and other small engines, small businesses and household activities, or biogenic sources, such as a forest that releases hydrocarbons, may be referred to as nonpoint source.

Concentration – The relative amount of a substance mixed with another substance. Examples are 5 ppm of carbon monoxide in air and 1 mg/l of iron in water.

Emission – Release of pollutants into the air from a source. We say sources emit pollutants.

Emission Factor – The relationship between the amount of pollution produced and the amount of raw material processed. For example, an emission factor for a blast furnace making iron would be the number of pounds of particulates per ton of raw materials.

Emission Inventory – A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community; used to establish emission standards.

Flow Rate – The rate, expressed in gallons -or litres-per-hour, at which a fluid escapes from a hole or fissure in a tank. Such measurements are also made of liquid waste, effluent, and surface water movement.

Fugitive Emissions – Emissions not caught by a capture system.

Hydrocarbons (HC) – Chemical compounds that consist entirely of carbon and hydrogen.

Hydrogen Sulphide (H_2S) – Gas emitted during organic decomposition. Also, a by-product of oil refining and burning. Smells like rotten eggs and, in heavy concentration, can kill or cause illness.

Inhalable Particles – All dust capable of entering the human respiratory tract.

Nitric Oxide (NO) – A gas formed by combustion under high temperature and high pressure in an internal combustion engine. NO is converted by sunlight and photochemical processes in ambient air to nitrogen oxide. NO is a precursor of ground-level ozone pollution, or smog.

Nitrogen Dioxide (NO_2) – The result of nitric oxide combining with oxygen in the atmosphere; major component of photochemical smog.

Nitrogen Oxides (NO_x) – A criteria air polluant. Nitrogen oxides are produced from burning fuels, including gasoline and coal. Nitrogen oxides are smog formers, which react with volatile organic compounds to form smog. Nitrogen oxides are also major components of acid rain.

Mobile Sources – Moving objects that release pollution; mobile sources include cars, trucks, buses, planes, trains, motorcycles and gasoline-powered lawn mowers.

Particulates; Particulate Matter (PM-10) – A criteria air pollutant. Particulate matter includes dust, soot and other tiny bits of solid materials that are released into and move around in the air. Particulates are produced by many sources, including burning of diesel fuels by trucks and buses, incineration of garbage, mixing and application of fertilizers and pesticides, road construction, industrial processes such as steel making, mining operations, agricultural burning (field and slash burning), and operation of fireplaces and woodstoves. Particulate pollution can cause eye, nose and throat irritation and other health problems.

Parts Per Billion (ppb)/Parts Per Million (ppm) – Units commonly used to express contamination ratios, as in establishing the maximum permissible amount of a contaminant in water, land, or air.

PM10/PM2.5 – PM10 is measure of particles in the atmosphere with a diameter of less than 10 or equal to a nominal 10 micrometers. PM2.5 is a measure of smaller particles in the air.

Point Source – A stationary location or fixed facility from which pollutants are discharged; any single identifiable source of pollution; e.g. a pipe, ditch, ship, ore pit, factory smokestack.

Scrubber – An air pollution device that uses a spray of water or reactant or a dry process to trap pollutants in emissions.

Source – Any place or object from which pollutants are released.

Stack – A chimney, smokestack, or vertical pipe that discharges used air.

Stationary Source – A place or object from which pollutants are released and which does not move around. Stationary sources include power plants, gas stations, incinerators, houses etc.

Temperature Inversion – One of the weather conditions that are often associated with serious smog episodes in some portions of the country. In a temperature inversion, air does not rise because it is trapped near the ground by a layer of warmer air above it. Pollutants, especially smog and smog-forming chemicals, including volatile organic compounds, are trapped close to the ground. As people continue driving and sources other than motor vehicles continue to release smog-forming pollutants into the air, the smog level keeps getting worse.

1 INTRODUCTION

This report has been prepared by Wilkinson Murray in response to SEARs to accompany an Environmental Assessment Report (EAR) for a proposed S75W Modification Application to the Calderwood Concept Plan Approval (MP09_0082) (Approved Concept Plan) for the Calderwood Urban Development Project (CUDP).

The Calderwood Urban Development Project is a master planned community development by mostly Lendlease and other private developers.

The CUDP site is located within the Calderwood Valley in the Illawarra Region. It is approximately 700 hectares in area with approximately 107 hectares of land in the Wollongong LGA (15%) and the balance in the Shellharbour LGA (85%). Refer to Location Plan at Figure 1-1 and Concept Plan at Figure 1-2.

Calderwood Valley is bound to the north by Marshall Mount Creek (which forms the boundary between the Shellharbour and Wollongong LGAs), to the south by the Macquarie Rivulet, to the south-west by Johnston's Spur and to the west by the Illawarra Escarpment. Beyond Johnston's Spur to the south is the adjoining Macquarie Rivulet Valley within the locality of North Macquarie. The CUDP site extends south from the intersection of North Marshall Mount Road and Marshall Mount Road to the Illawarra Highway.

The proposed modification to the Approved Concept Plan seeks to increase the total provision of housing (approximate number of dwellings) within the overall CUDP to respond to market demand for the provision of smaller housing types / lot sizes at affordable price points and to ensure the efficient use of urban zoned land within this context for the supply of housing.

It is proposed to increase the overall number of dwellings to be delivered within the existing area of land zoned R1 General Residential and B4 Mixed Use and also approved for urban development as shown on the Approved Concept Plan from approximately 4,800 to approximately 6,500 dwellings.

The SEARs are summarised below:

17. Air Quality

- *Provide an air quality assessment for the proposed modification which considers any current air quality issues in the area, including potential cumulative impacts*

The EPA contact officer Paul Wearne was consulted by telephone on Monday 4 June 2018, prior to the issue of the report.

Figure 1-1 Location Plan

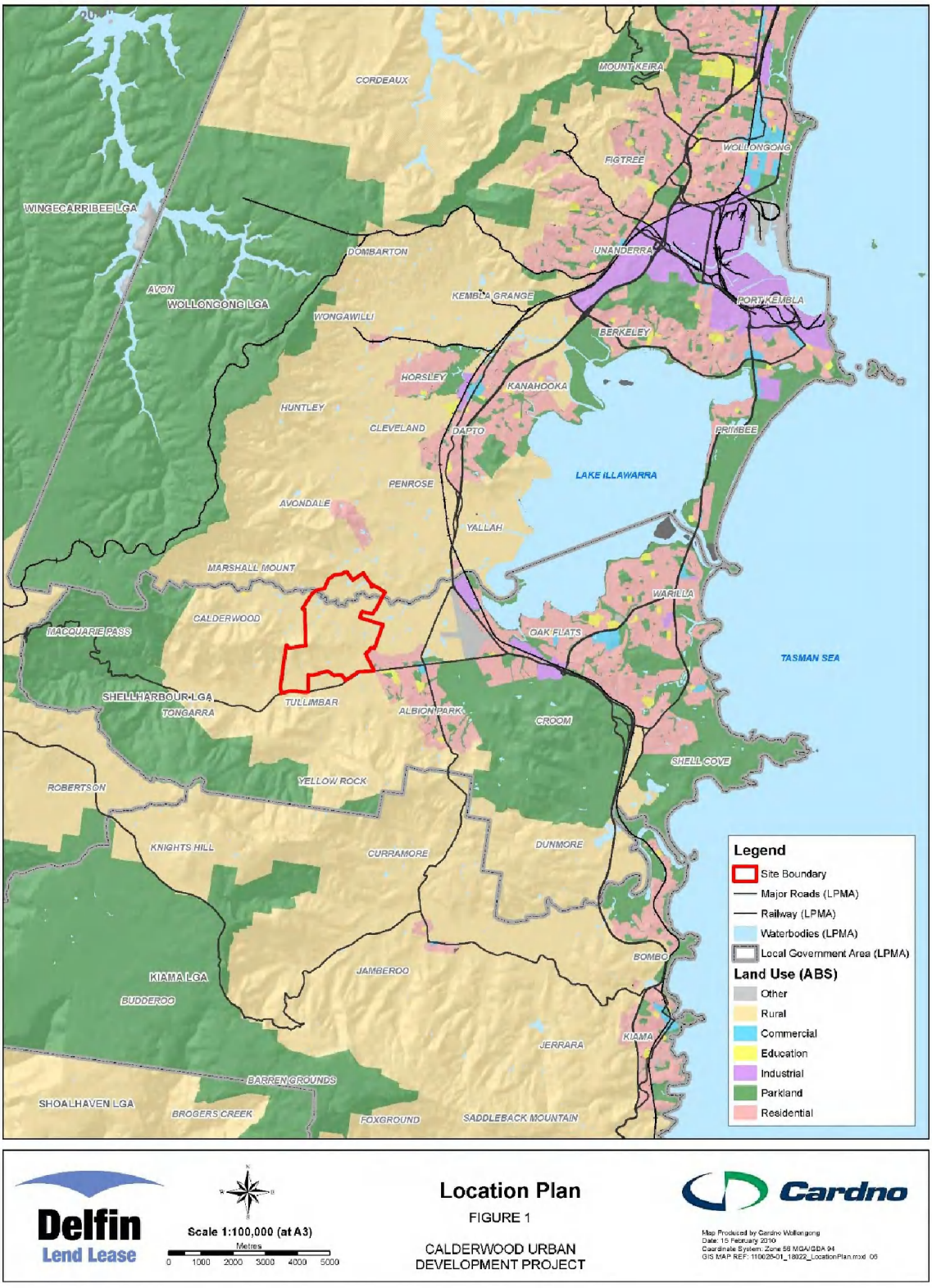
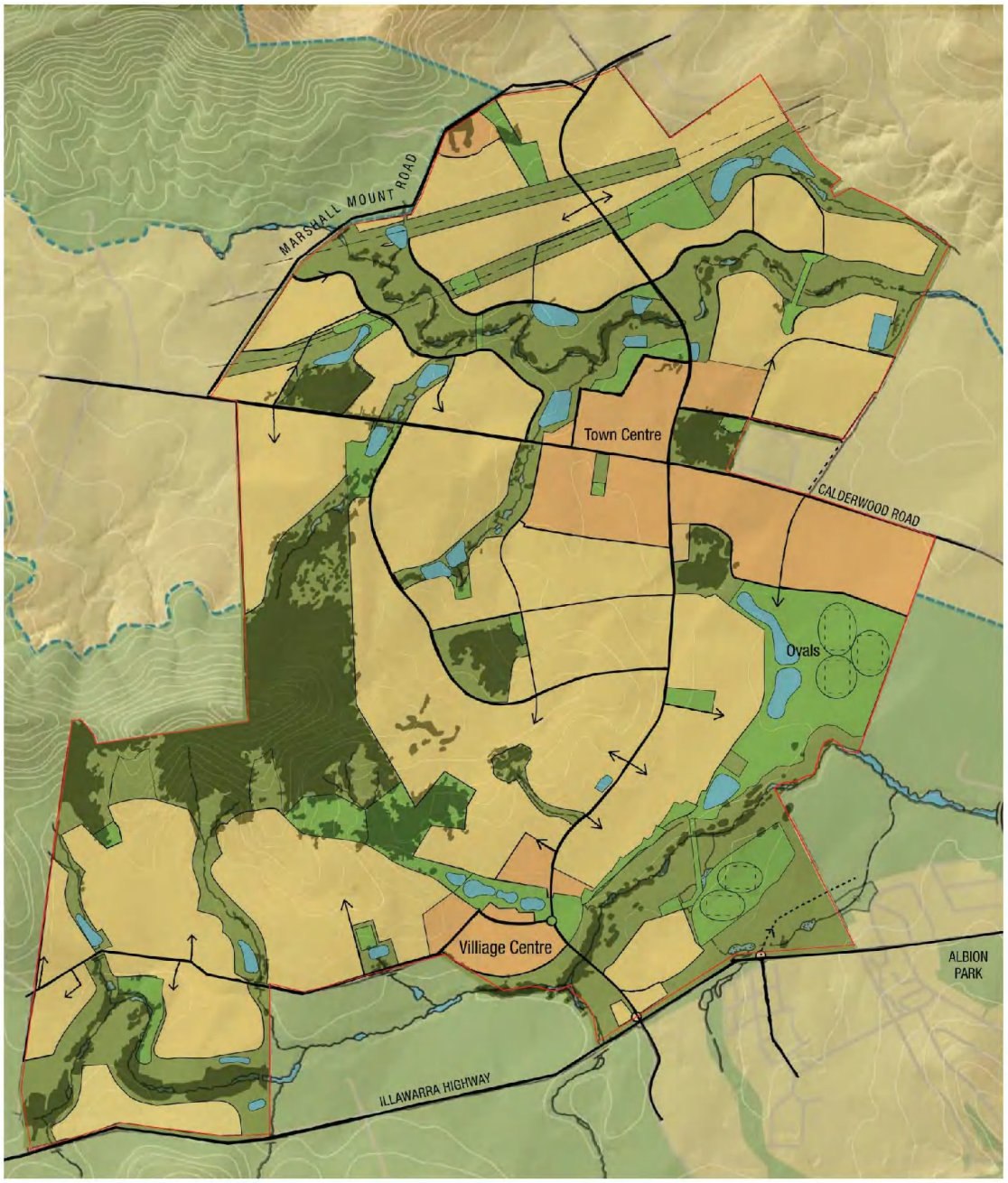


Figure 1-2 Concept Plan



Concept Plan (MOD 4)

Town and Village Centres
Mixed Uses including Retail, Employment, Residential, Learning and Community Amenities

Residential Neighbourhoods

Parks
eg Citywide, district and local parks

Principal Open Space and Drainage
eg Environmental Conservation, Environmental Management and Drainage Corridors

Indicative Water Bodies

lendlease

n

1 ha

0 100 500 1000m

Subject to verification and detailed site survey 1:20,000 @ A4 10m Contours July 2018

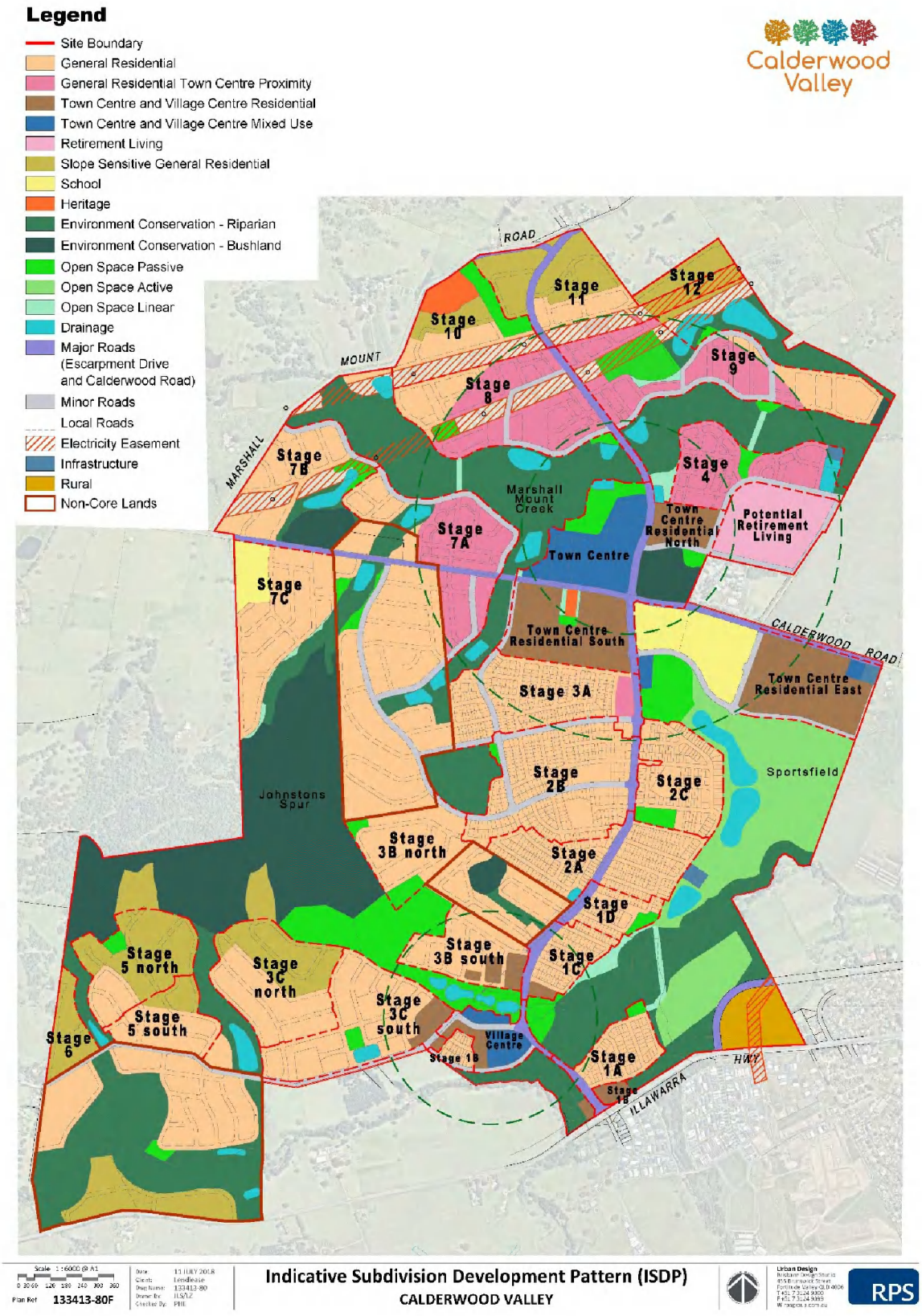
2 SITE DESCRIPTION

The CUDP site is located within the Calderwood Valley in the Illawarra Region. It is approximately 700 hectares in area with approximately 107 hectares of land in the Wollongong LGA (15%) and the balance in the Shellharbour LGA (85%).

Calderwood Valley is bound to the north by Marshall Mount Creek (which forms the boundary between the Shellharbour and Wollongong LGAs), to the south by the Macquarie Rivulet, to the south-west by Johnston's Spur and to the west by the Illawarra Escarpment. Beyond Johnston's Spur to the south is the adjoining Macquarie Rivulet Valley within the locality of North Macquarie. The CUDP site extends south from the intersection of North Marshall Mount Road and Marshall Mount Road to the Illawarra Highway.

The proposed development is illustrated on Figure 2-1 and shows the concept for the development which includes areas allocated to residential uses, mixed use areas, educational facilities and employment areas. The residential areas up to Stage 3A are approved and are either developed and occupied or under construction. To date, Lendlease has sold 1,100 lots in those stages, with development applications lodged for Stages 3B South and 3C. The later stages and Town Centres are yet to be developed.

Figure 2-1 Indicative Layout Plan



3 AIR QUALITY OBJECTIVES

Air quality criteria are benchmarks set to protect the general health and amenity of the community in relation to air quality. The NSW EPA's *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016) sets out applicable impact assessment criteria for a number of air pollutants. These criteria, presented in Table 3-1, are consistent with the National Environment Protection Measures (NEPM) for Ambient Air Quality.

Table 3-1 Impact assessment criteria – dust and particulate matter

Pollutant	Averaging period	Concentration	
		pphm	**µg/m³**
Sulfur dioxide (SO_2)	10 minutes	25	712
	1 hour	20	570
	24 hours	8	228
	Annual	2	60
Nitrogen dioxide (NO_2)	1 hour	12	246
	Annual	3	62
Photochemical oxidants (as ozone)	1 hour	10	214
	4 hours	8	171
Lead	Annual	-	0.5
$PM_{2.5}$	24 hours	-	25
	Annual	-	8
PM_{10}	24 hours	-	50
	Annual	-	25
Total suspended particulates (TSP)	Annual	-	90
		g/m²/month [a]	**g/m²/month** [b]
Deposited dust [c]	Annual	2	4
		ppm	**mg/m³**
Carbon monoxide (CO)	15 minutes	87	100
	1 hour	25	30
	8 hours	9	10
		µg/m³ [d]	**µg/m³** [e]
Hydrogen fluoride	24 hours	2.9	1.5
	7 days	1.7	0.8
	30 days	0.84	0.4
	90 days	0.5	0.25

a. Maximum increase in deposited dust level.
b. Maximum total deposited dust level.
c. Dust is assessed as insoluble solids as per AS 350.10.1-1991 (AM-19).
d. General land use, which includes all areas other than specialized land use.
e. Specialized land use, which includes all areas with vegetation sensitive to fluoride, such as grape vines and stone fruits.

4 EXISTING ENVIRONMENT

4.1 Local Climate

4.1.1 Long Term Climate Averages

Long term meteorological data for the area surrounding the Project site is available from the Bureau of Meteorology (BoM) operated weather station at the Illawarra Regional Airport. The Illawarra Regional Airport is located approximately 3 kilometres east of the Project site and records observations of a number of meteorological data including temperature, humidity, rainfall, wind speed and wind direction.

Long-term climate statistics are presented in Table 4-1. Temperature data recorded at the Illawarra Regional Airport indicates that January is the hottest month of the year, with a mean daily maximum temperature of 27.0°C. July is the coolest month with a mean daily minimum temperature of 6.3°C. February is the wettest month with an average rainfall of 141 mm falling over 9 days. There are on average 80 rain days per year, delivering 926 mm of rain.

Table 4-1 Long-term climate averages – Illawarra Regional Airport

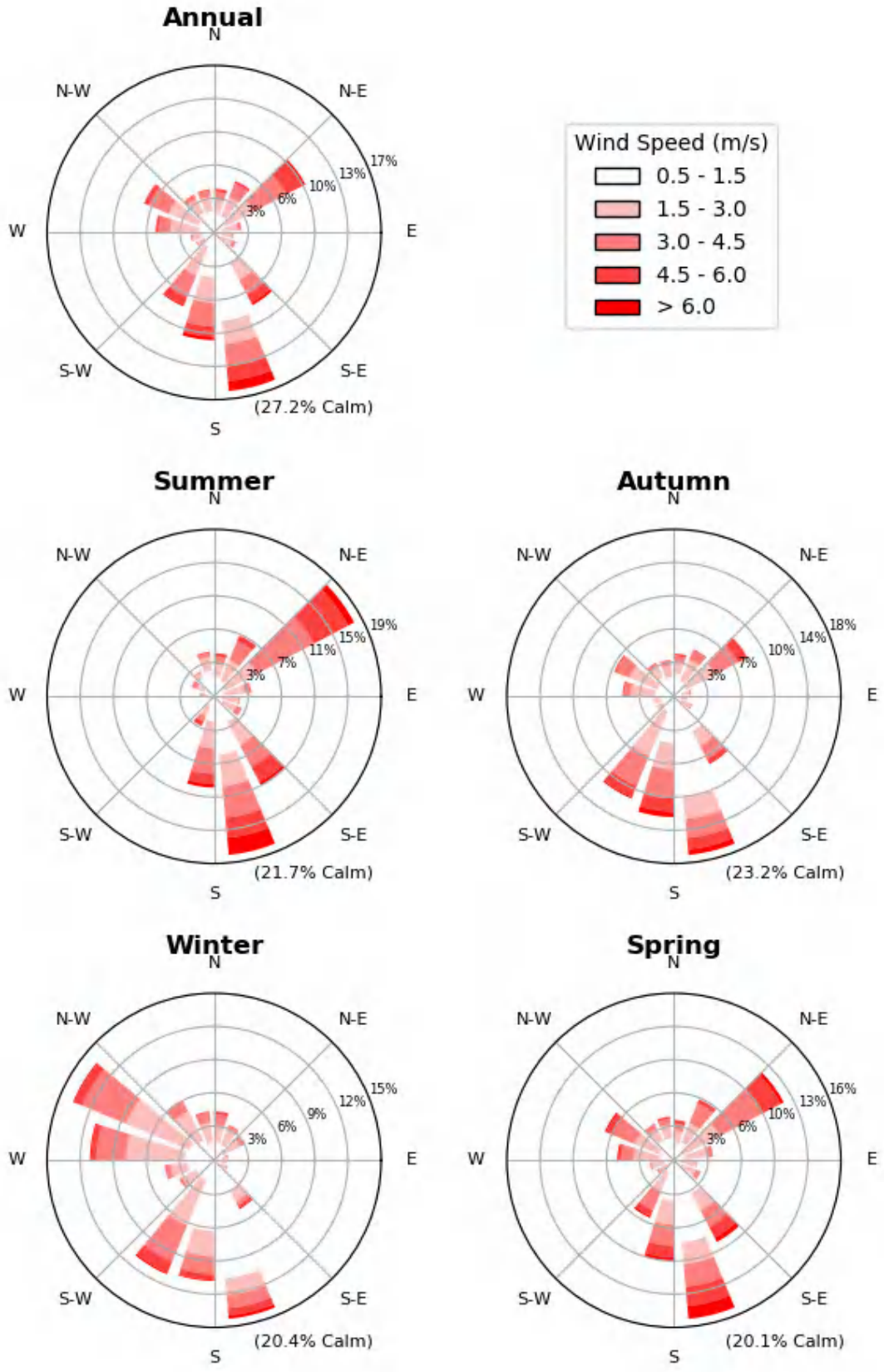
Observation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9am Mean Observations													
Temperature (°C)	22.5	22.0	20.2	19.2	15.8	13.0	12.5	14.0	17.1	19.0	19.7	21.4	18.0
Humidity (%)	68	74	76	68	69	73	68	61	57	58	67	66	67
3pm Mean Observations													
Temperature (°C)	24.8	24.5	23.5	21.3	18.8	16.7	16.2	17.3	19.3	20.4	21.6	23.5	20.7
Humidity (%)	63	67	64	61	58	57	54	49	53	58	63	61	59
Daily Minimum and Maximum Temperatures													
Minimum (°C)	16.9	17.1	15.6	12.2	8.8	7.2	6.3	6.5	8.5	10.8	13.4	15.3	11.5
Maximum (°C)	27.0	26.3	25.3	23.3	20.6	18.1	17.6	18.8	21.4	23.1	24.0	25.6	22.6
Rainfall													
Rainfall (mm)	72.9	140.5	122.3	73.8	58.1	94.5	51.4	55.3	42.7	64.5	83.1	67.0	925.6
Rain days	7.8	8.6	7.9	7.1	4.9	6.3	4.8	4.5	5.1	6.4	8.2	8.1	79.7

4.1.2 Distribution of Wind Speed and Direction

Data from the Office of Environment and Heritage (OEH) operated air quality monitoring station (AQMS) at Albion Park South has been chosen to best represent the typical wind speed and direction in the area surrounding the Project. The Albion Park South AQMS is located approximately 3 kilometres east of the Project site.

Windrose plots showing the distribution of wind direction and wind speed at the Albion Park South AQMS between 2013 and 2017 are presented in Figure 4-1.

Figure 4-1 Windroses – OEH Albion Park AQMS, 2013 – 2017



4.2 Local Ambient Air Quality

Air Quality monitoring data OEH AQMS at Albion Park South has been used to characterise the ambient air quality in the area surrounding the project site. The following sections present a summary of the air quality monitoring results at the Albion Park South AQMS over the period 2013 – 2017.

4.2.1 Sulfur dioxide

Observations of ambient SO_2 concentrations at the Albion Park South AQMS during 2013 – 2017 are presented in Table 4-2. No exceedances of the goals for SO_2 were recorded.

Table 4-2 Ambient SO_2 – Albion Park South AQMS, 2013 – 2017

Year	1-hour Average (goal = 20 pphm)			24-hour Average (goal = 8 pphm)			Annual Average (goal = 2 pphm)
	Min	Max	Exceedances	Min	Max	Exceedances	
2013	0.0	3.9	-	0.0	0.9	-	0.1
2014	0.0	1.6	-	0.0	0.5	-	0.1
2015	0.0	3.6	-	0.0	0.7	-	0.1
2016	0.0	2.2	-	0.0	0.6	-	0.1
2017	0.0	3.0	-	0.0	0.8	-	0.1

4.2.2 Nitrogen dioxide

Observations of ambient NO_2 concentrations at the Albion Park South AQMS during 2013 – 2017 are presented in Table 4-3. No exceedances of the goals for NO_2 were recorded.

Table 4-3 Ambient NO_2 – Albion Park South AQMS, 2013 – 2017

Year	24-hour Average (goal = 12 pphm)			Annual Average (goal = 3 pphm)
	Minimum	Maximum	Exceedances	
2013	0.0	3.9	-	0.4
2014	0.0	3.8	-	0.4
2015	0.0	4.7	-	0.3
2016	0.0	4.3	-	0.4
2017	0.0	3.8	-	0.4

4.2.3 Ozone

Observations of ambient O_3 concentrations at the Albion Park South AQMS during 2013 – 2017 are presented in Table 4-4. On several occasions during 2013, 2016 and 2017, ambient O_3 concentrations at Albion Park South exceeded the goal. According to the NEPM compliance reports, these exceedances were attributed to either bushfires or hot and calm summer weather.

Table 4-4 Ambient O_3 – Albion Park South AQMS, 2013 – 2017

Year	1-hour Average (goal = 10 pphm)		
	Minimum	Maximum	Exceedances
2013	0.3	12.0	4
2014	0.5	9.4	-
2015	0.5	7.9	-
2016	0.7	10.4	2
2017	0.4	11.7	4

4.2.4 $PM_{2.5}$

Observations of ambient $PM_{2.5}$ concentrations at the Albion Park South AQMS during 2013 – 2017 are presented in Table 4-3, noting that $PM_{2.5}$ observations at Albion Park South began in 2015. The 24-hour goal for $PM_{2.5}$ was exceeded on two occasions during 2016. These exceedances of the goal coincided with hazard reduction burning.

Table 4-5 Ambient $PM_{2.5}$ – Albion Park South AQMS, 2013 – 2017

Year	24-hour Average (goal = 25 µg/m³)			Annual Average (goal = 8 µg/m³)
	Minimum	Maximum	Exceedances	
2013	No Data			
2014				
2015	0.6	21.1	-	6.4
2016	1.9	30.7	2	7.2
2017	0.2	19.3	-	6.6

4.2.5 PM_{10}

Observations of ambient PM_{10} concentrations at the Albion Park South AQMS during 2013 – 2017 are presented in Table 4-3. The 24-hour average PM_{10} concentration exceeded the goal of 50 µg/m³ on two days in 2013, during a severe bushfire event.

Table 4-6 Ambient PM_{10} – Albion Park South AQMS, 2013 – 2017

Year	24-hour Average (goal = 50 µg/m³)			Annual Average (goal = 25 µg/m³)
	Minimum	Maximum	Exceedances	
2013	2.6	69.0	2	14.7
2014	4.1	48.3	-	16.2
2015	2.8	41.2	-	14.0
2016	3.5	43.1	-	14.9
2017	3.4	44.6	-	15.3

In summary, the ambient air quality in the area surrounding the Project, as described by the data from the Albion Park South AQMS, is typically good to very good. The ambient concentrations of all monitored air pollutants are below criteria, except where they have been influenced by extreme events such bushfires and hazard reduction burning, and by extreme weather conditions.

5 AIR QUALITY IMPACT ASSESSMENT

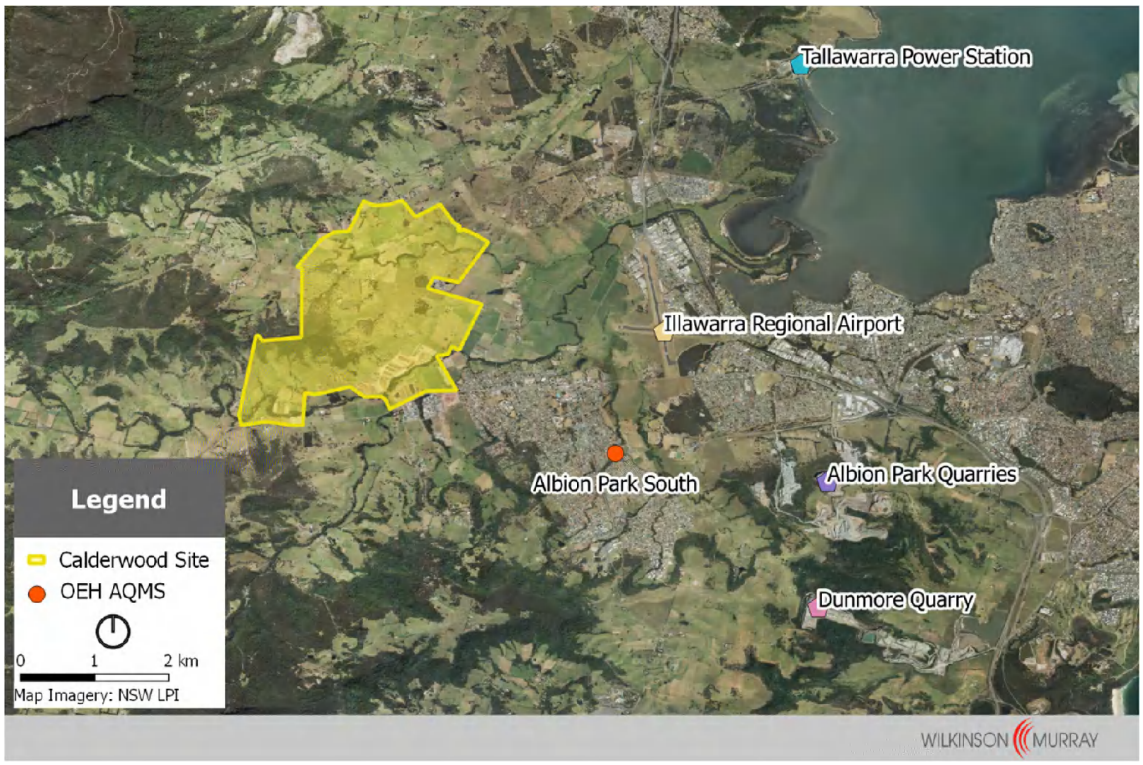
5.1 Existing Sources and Ambient Air Quality

A few existing activities with the potential to affect air quality have been identified in the area surrounding the Project. These activities are summarised in Table 5-1 and shown on Figure 5-1.

Table 5-1 Nearby Potential Sources of Air Pollutants

Source	Description
Tallawarra Power Station	Natural gas fired power station, located approximately 6 km north-east of the Project.
Illawarra Regional Airport	Licenced airport servicing ultra-light to medium size turbo prop and jet aircraft. Located approximately 3 km east of the Project.
Albion Park & Dunmore Hard Rock Quarries	Hard rock quarries located more than 5 km south east of the Project

Figure 5-1 Nearby Potential Sources of Air Pollutants



As described in Section 4.2, the existing ambient air quality at the Albion Park South AQMS, is typically good to very good. Figure 5-1 shows that the Albion Park South AQMS is well separated from existing sources of air pollutants, and that the Project site has even greater separation from these activities. Therefore, air quality impacts within the Project site, due to nearby existing activities, is considered unlikely.

5.2 Changes Due to the Project

The Project itself will result in additional potential sources of air pollutants near future sensitive land uses within the Project site. Some of these sources will be temporary, while others will be ongoing.

5.2.1 Construction of the Project Stages

The Project is a staged development. Therefore, the construction of some stages of the Project will occur at a time when prior stages of the Project have been completed and are occupied by residents. Accordingly, there is a potential for construction dust impacts.

The Construction Environmental Management Plan (CEMP) for each stage of the Project should include measures to minimise construction dust impacts. These measures may include the following:

- Watering and/or covering exposed areas and stockpiles;
- Rehabilitating exposed areas as soon as practicable;
- Using water carts on haul routes;
- Covering loads on vehicles transporting materials; and,
- Using wheel washes to prevent mud being tracked onto roads.

5.2.2 Traffic on Major Roads

The NSW Department of Planning document *Development Near Rail Corridors and Busy Roads – Interim Guideline* provides guidelines for compliance with the requirements of the State Environmental Planning Policy (Infrastructure) 2007 (iSEPP), which was introduced to provide guidelines for new dwellings built beside road and rail corridors.

The iSEPP applies to road corridors with an AADT greater than 40,000 and is recommended for road corridors greater than 20,000 AADT.

There are two major roads through the Project (Escarpment Drive, which runs north south connecting the Illawarra Highway with Marshall Mount Road via the Town Centre and Calderwood Road which primarily runs east west via the Town Centre) which have the highest traffic volumes, particularly post development. The traffic volumes along all these roads are predicted to be in the order of 10-15,000 vehicles per day by 2036.

The predicted traffic volumes don't trigger the 40,000 vpd where an iSEPP assessment is required or even the 20,000 vpd where assessment is recommended. Nevertheless, the iSEPP guideline provides useful guidance for identifying situations where air quality impacts should be considered.

The iSEPP guideline for building near busy roads gives detailed advice when air quality should be a design consideration, namely:

- *"Within 10 metres of a congested collector road (traffic speeds of less than 40 km/hr at peak hour) or a road grade > 4% or heavy vehicle percentage flows > 5%,*
- *Within 20 metres of a freeway or main road (with more than 2500 vehicles per hour, moderate congestions levels of less than 5% idle time and average speeds of greater than 40 km/hr),*

- *Within 60 metres of an area significantly impacted by existing sources of air pollution (road tunnel portals, major intersection / roundabouts, overpasses or adjacent major industrial sources), or*
- *As considered necessary by the approval authority based on consideration of site constraints, and associated air quality issues."*

None of these scenarios are considered likely to be relevant to the Project. Accordingly, air quality impacts associated with road traffic are highly unlikely.

5.2.3 Household Emissions – Wood Heaters

Wood heaters represent the most significant source of particle emissions from households. According to the NSW EPA, wood heaters contribute 6% and 19% of annual PM_{10} and $PM_{2.5}$ pollution, respectively in the Greater Metropolitan Region. During winter months, wood heaters contribute up to 18% and 44% of monthly PM_{10} and $PM_{2.5}$ particle emissions, respectively.

Council approval is required for the installation of wood heaters. It is anticipated that the approval process would include an assessment of the proposed installation of wood heaters in accordance with current advice from NSW EPA and as updated in the future.

5.2.4 Increased Number of Dwellings

The Proposal seeks to increase the number of dwellings to be delivered within the existing area of land zoned R1 General Residential and B4 Mixed Use and also approved for urban development as shown on the Approved Concept Plan from approximately 4,800 to approximately 6,500 dwellings – and increase of approximately 35%.

The preceding Sections of this report have demonstrated that the existing ambient air quality at the Project site ranges from good to very good, indicating that the area is suitable for residential development, and that the Project itself is unlikely to result in air quality impacts. Similarly, increasing the number of dwellings by approximately 35%, the objective of the S75W modification, is considered unlikely to result in unacceptable air quality impacts.

6 CONCLUSION

The air quality aspects of the proposed Calderwood Urban Development Project have been investigated. It has been concluded that:

- The existing ambient air quality in the area surrounding the Project site is good to very good;
- Air quality impacts from existing activities in the area surrounding the Project site are unlikely;
- The CEMP for each stage of the Project should include measures to minimise construction dust impacts;
- Air quality impacts from vehicles on major roads are unlikely;
- The installation and operation of wood heaters should be consistent with the advice from NSW EPA, as updated in the future; and,
- The proposed increase in the total number of dwellings is unlikely to affect any of the above conclusions.

Accordingly, it has been determined, that from an air quality perspective, the Project site is suitable for residential and mixed use development and that the proposed S75W modification is considered unlikely to result in unacceptable air quality impacts.